Blue Horizons III (2009)

The Age of Surprise

Implications of Exponential Technological Change on Air Force Strategy Through 2035

Center for Strategy and Technology

Colonel John Geis

We Produce the Future

Purpose

This briefing is not asking for money, proposing new systems or attacking the way things have been done to date . . .

It’s sole purpose is to introduce a way of thinking about the future that will result in changing attitudes, priorities and expectations . . .

Center for Strategy & Technology
Air University

What we do

Assess strategic impact of rapidly accelerating technological change

Blue Horizons Program

A CSAF directed study on future strategy and technology to inform the debate on AF future thinking and investment

Sponsors

- A8
- AFRL

Researchers

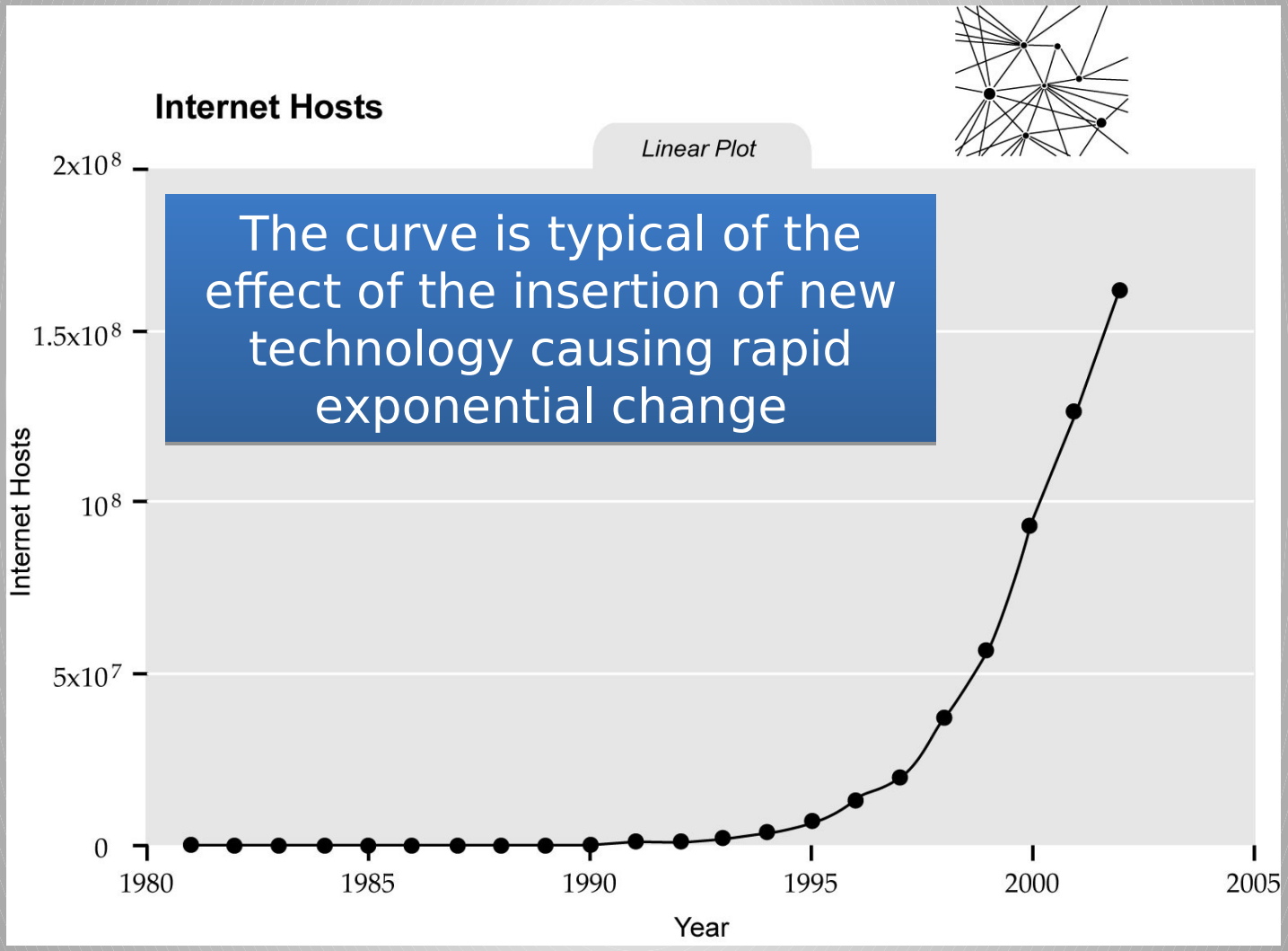
- Air War College
- Air Command and Staff

Research Support

- AFRL
- Sandia National Lab

An introspective briefing ***built by Airmen for Airmen***

The J Curve and Rapid Exponential Change



Harsh Realities

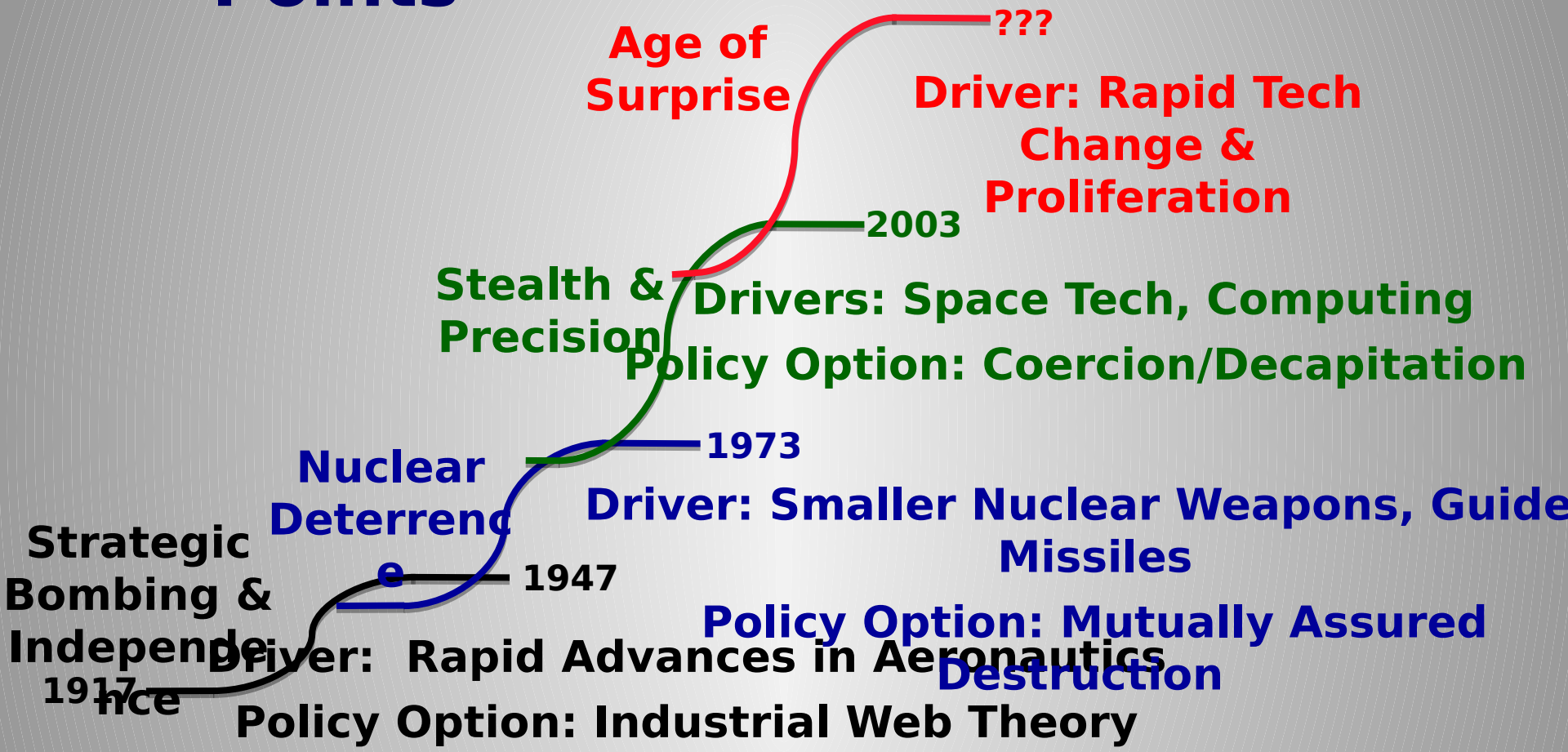
Why the Air Staff squelches these kinds of briefings

- “We’re at war – talk to us after the fight”
- “It’s all about the money – not enough for today…”
- “This is Next-War-itis writ large – need a grip on today”
- “This briefing is all Star Wars”

Yet why it is critical to the Air Force

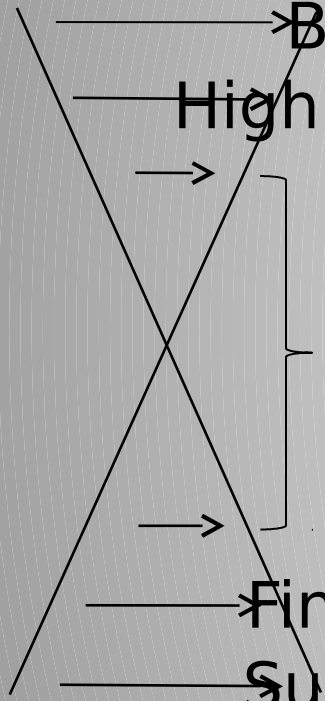
- Historic niche for the AF – see the future, innovate and capture the next technology wave
- Today's reality – an unsustainable “boots on the ground” strategy
- Tomorrow’s reality – radical change spawned by technology revolutions

USAF Strategic Inflection Points



From the beginning, Airmen were innovators with vision to see beyond today and find the future capability to defend the nation

Overview



Brief Introduction

Highlights from Previous Blue Horizons Studies

Bio/Cyber: Two Examples of Exponential Technological Change to Explore Future Airmen Development

Findings – Implications for the AF

Summary and Recommendations

A8 Taskings for Blue Horizons

2007: Blue Horizons I

- Validate technology increasing at exponential rate
- Detail ramifications of exponential technological change through 2025

2008: Blue Horizons II

- Based on BH I – created 4 alternate futures for 2030
- Prioritized concepts and enabling technologies for AF investment

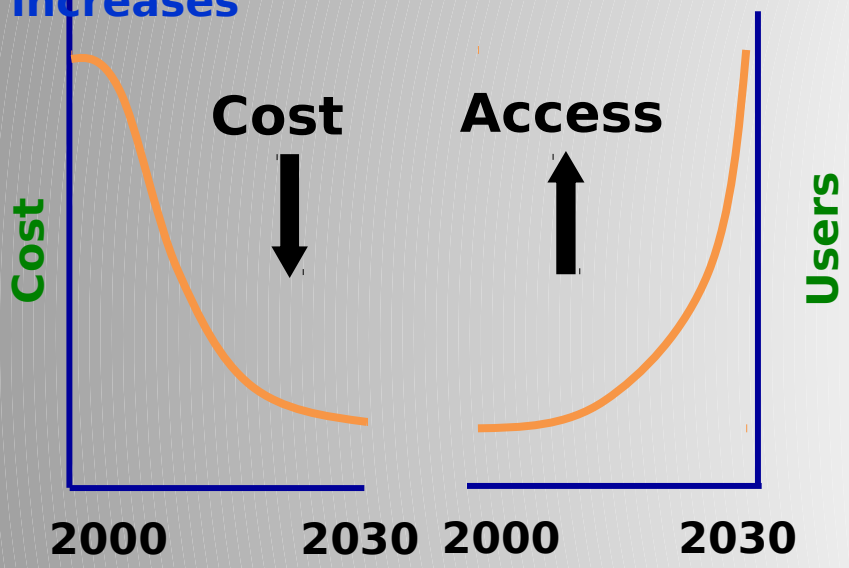
The New Battlespace

- Future enemies
  - ***motivated*** by resources, fear, and hate;
  - ***empowered*** through education; and
  - ***enabled*** through technology and globalization to directly challenge the US
- The ***enemy*** will be different – the targets they present will be more ***difficult*** to find, ***harder*** to hit, more widely ***distributed***, and more ***dangerous***

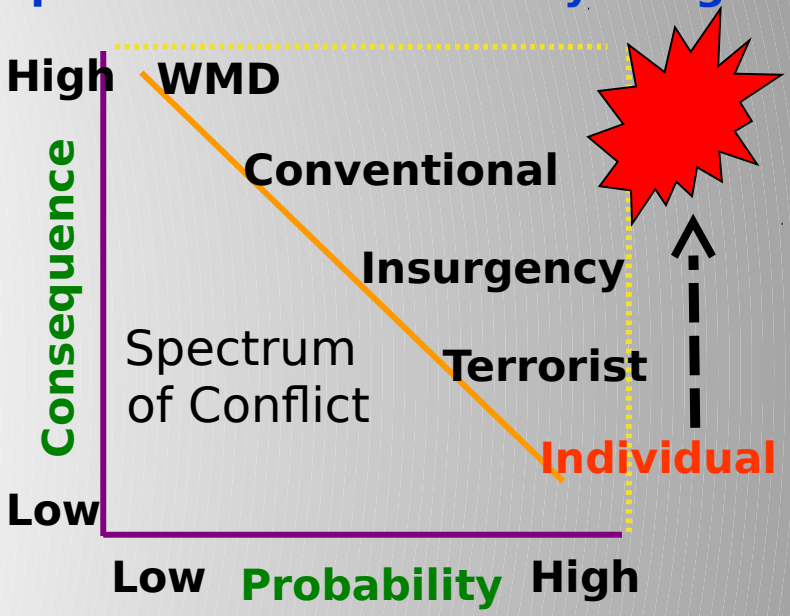
The implications of these changes will shift the foundations of today's Air Force structure

Blue Horizons I (2007)

Cost of tech decreases – availability increases



Most probable becomes very dangerous



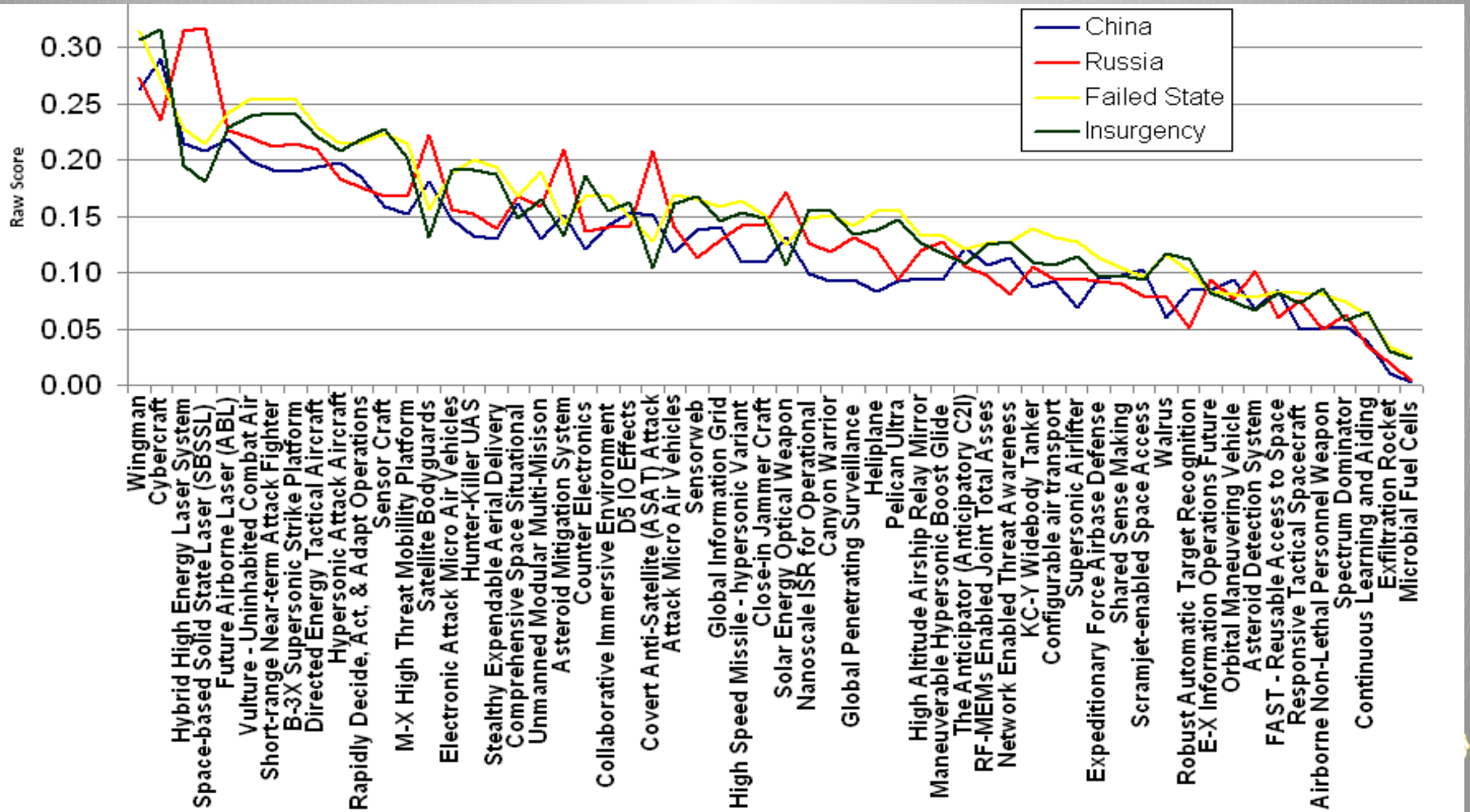
Demonstrated the ***proliferation*** of high tech systems

from the nation to the group to the individual

Blue Horizons II (2008)

- HQ USAF/A8 tasking:

  "…develop ***a prioritized list of concepts and their key enabling technologies*** that the U.S. Air Force will need to maintain the dominant air and space forces in the future"



Blue Horizons I and II Bottom Line

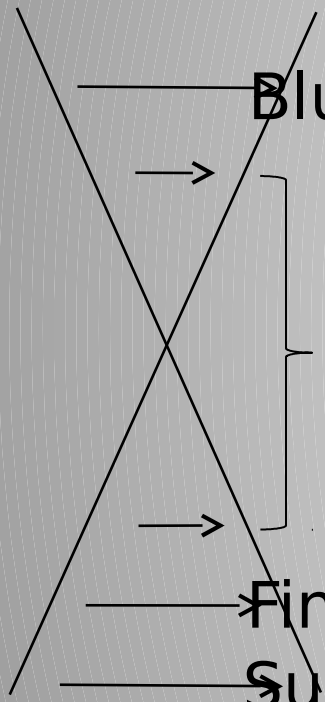
Exponential Technological Change is

Real
Inevitable
Driving Proliferation
Result of Synergies in Nano/Bio/Cyber
Privately Led…Governments Shape Margins

Purpose of Blue Horizons III

- Given ***"head nods"*** all around in response to Blue Horizons I and II, Blue Horizons III asked:
  - What changes in Air Force culture and organization are needed to address disruptive technology?
  - How will Exponential Technological Change affect employment in the air, space and cyber domains?
  - What changes in Airmen development are needed to deal with the world of 2035?

Exponential Tech Change - Bio



Blue Horizons Results

Bio/Cyber: Two Examples of Exponential Technological Change to Explore Future Airmen Development

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Summary and Recommendations

Changing Role of Man and Machine

Man is the machin

Man's "value added" is shifting: physical to cognitive to *ethical*

Man controlling the machine

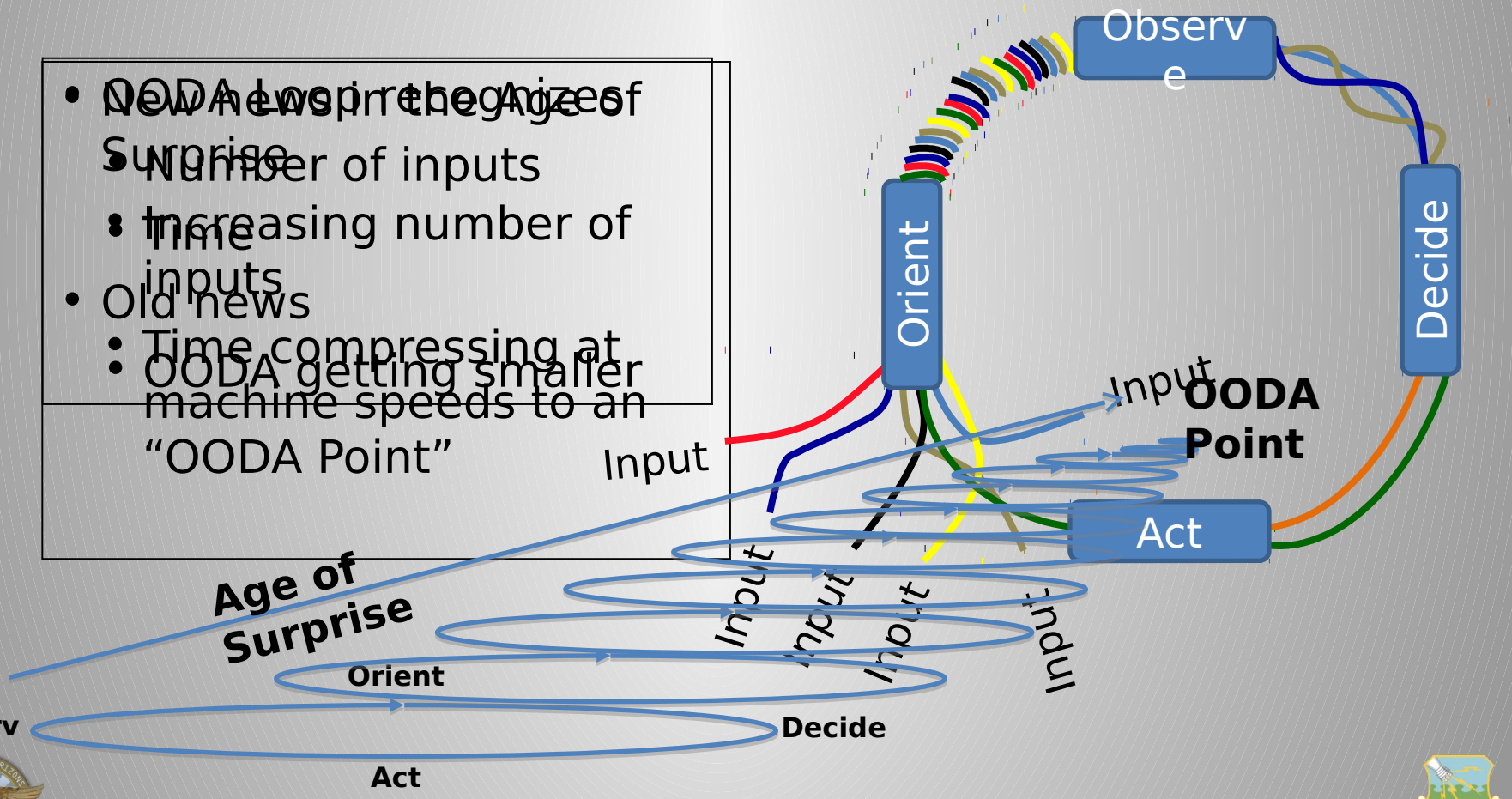
n employing the machine

Man observing the machine

Impact: Human Driven Out of the Loop

Exponential Technological Change forces humans out of the decision loop

- New news in the Age of Surprise
  - Number of inputs
  - Increasing number of inputs
- Old news
  - Time compressing at machine speeds to an "OODA Point"
  - OODA getting smaller



The Man in the Loop Dilemma

Policy Assumption

- Man will stay in the control loop
- Result: No Ethical Dilemma

Reality

- Constant and persistent drive to increase autonomous capability
- Belief that brilliant machines will avoid human error generated by fear, emotion, agenda, speed or facts

In fact, Exponential Technological Change is outpacing the ethical programming of unmanned technology

Approaches to Keep Man in the Loop

Artificial Intelligence

- Machine to machine
- Autonomous action

Intelligence Augmentation

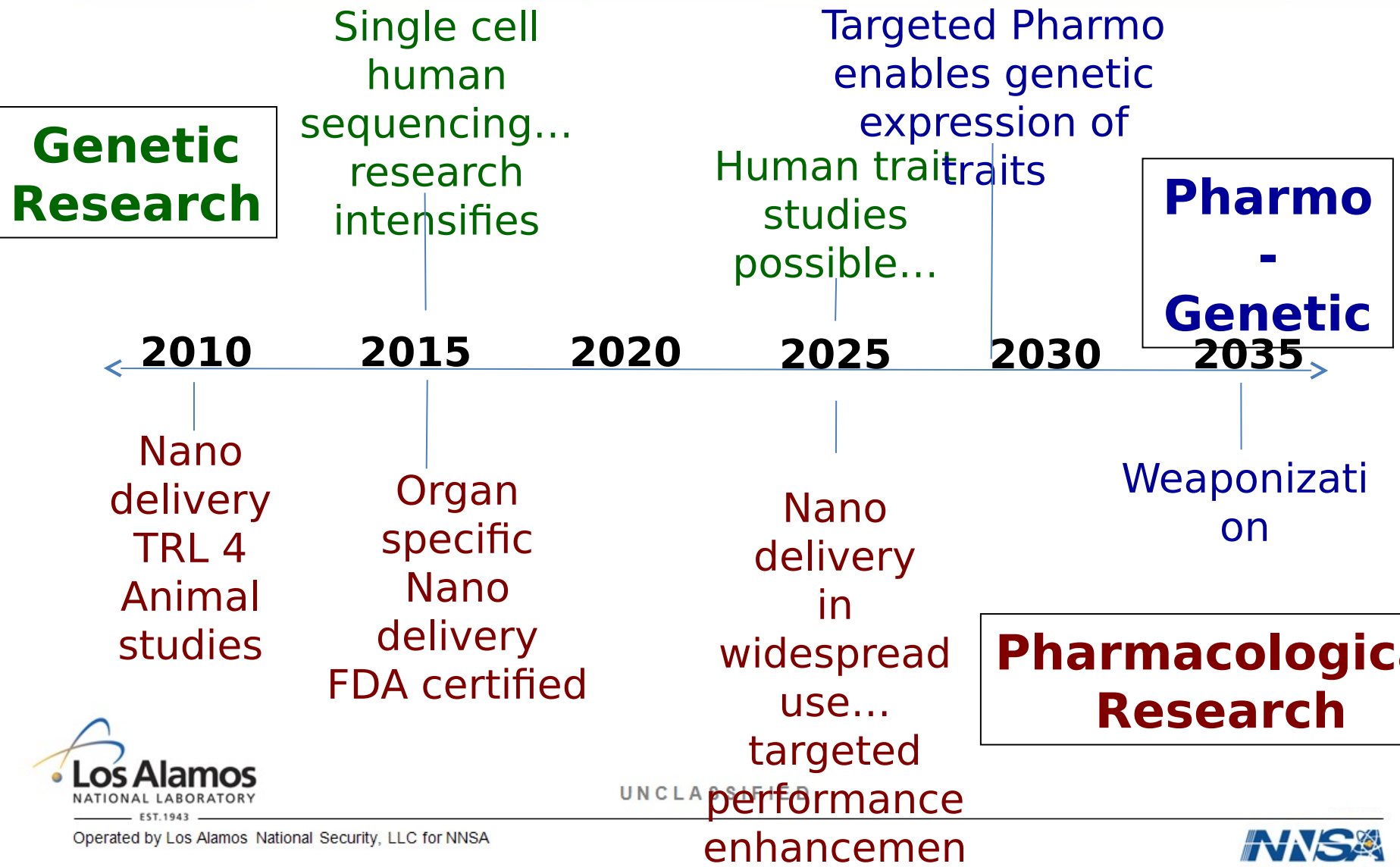
- Pharmacology
- Bio enhancement
- Human-Machine connectivity

Education & Training

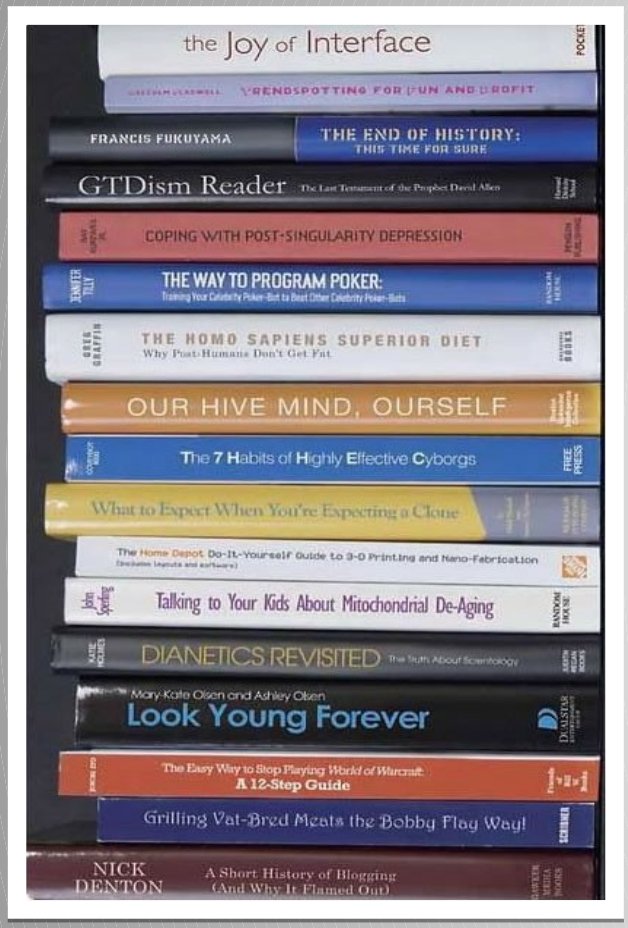
- Adjust requirements
- Foster agility
- Select/promote right players

Genomics Neuroscience Human Factors Education Training
Computer Science Psychology Pharmacology

Pharmo-Genetic Enhancement Timeline



Education and Training



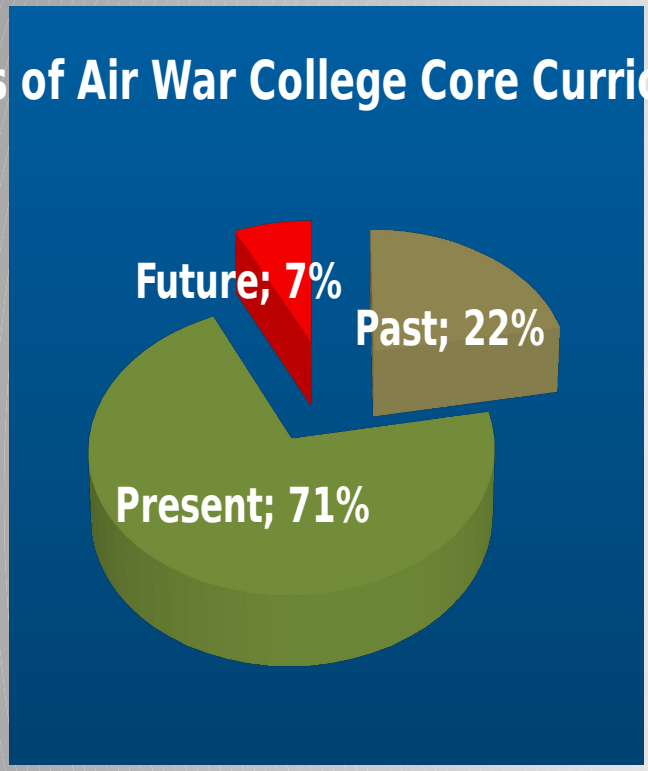
We can not know the future but

we *can*:

- Create a ***"Man for all Seasons"*** through creative educational techniques
- Instill a ***philosophical*** and ***psychological*** capacity to expect and accept surprise caused by rapid technological change
- Foster and encourage flexible ***agile thinking***
- Generate a drive for ***innovation*** with attendant acceptance of ***risk***
- Provide virtual reality training to prepare

TRAIN for certainty – *EDUCATE* for uncertainty

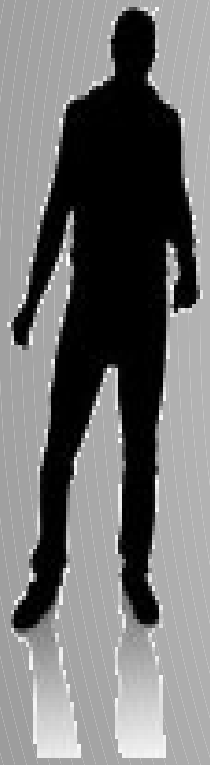
Example of the Problem



- No Instructional Plans dedicated to technology or the impact of technology
- Very limited look into the future – and that only through the FYDP
- USAF supposed to be DoD's technical leader – it is what is expected of us

In historic flat part of "J" curve, this breakout was adequate. As tech change accelerates, education and training must adapt

Take Aways
Keeping Man in the Loop

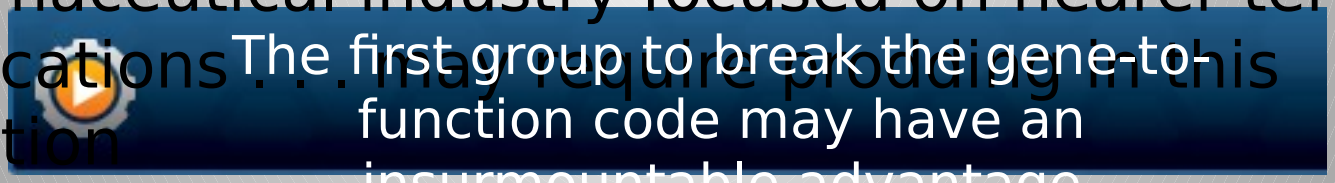


Air Force future leader:

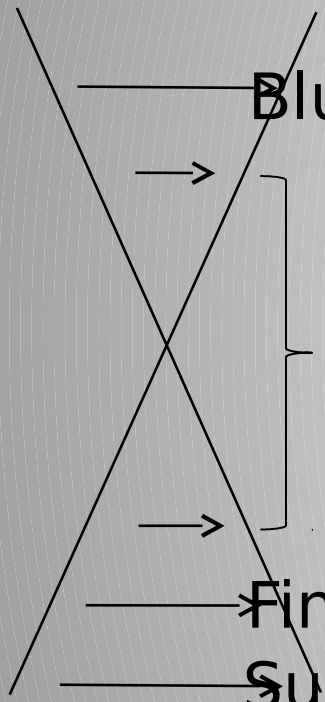
- Selected based on demonstrated proclivity for success in a chaotic environment, genetics and way of thinking
- Educated to instill a ***philosophical*** and ***psychological*** capacity to expect and accept surprise
- Cognitively enhanced through Pharmo-genetic technology
- Trained in a virtual reality environment . . . conditioned to think clearly and rapidly . . . brings ethics into machine dominated world

Surprise #1
Rosetta Stone

- We have decoded the human genome, but lack a gene-to-function Rosetta Stone
  - Lack computational power, algorithms . . . ethics block research
  - Don’t have full set of behavioral traits or understand how the psyche affects cognition
  - Not being extensively researched in national labs
  - Requires intensive intelligence monitoring on private sector research
  - Deserves military R&D effort
  - **Potentially, next ‘Manhattan Project’**
- Pharmaceutical industry focused on nearer term applications . . . may require prodding in this direction



Exponential Tech Change - Cyber



Blue Horizons Results

Bio/Cyber: Two Examples of Exponential Technological Change to Explore Future Airmen Development

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Summary and Recommendations

Trajectory of Cyber Development

1980

- TV
- Telephones
- Computers

2010

- PDA
- Computers
- Internet
- "Cyber Attack and Defense"

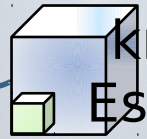
2035

- Transparency
- World net

Knowledge and things combine in "one machine"– results in era of transparency

Connections/computing result in proliferation of knowledge

Establishing Connections



Cyber in 2035

- Not better . . . radically different
- Driven by innovation . . . not governments
- Transparency changes the game
- “Dominance” not possible

Beyond Big Brother: Transparency in 2035

Cyber vector: "One Machine"

- World interconnectedness creates "One Machine"
- One Machine constantly
  - Redesigns itself moment to moment
  - Develops new architectures daily
  - Never fails (nodes may fail but not the "Machine")
  - Innovates – surprise the result

Beyond Big Brother: Transparency in 2035

Human vector: Drives reliance on Cyber

- Society, industry, government, military: Ever greater dependency on autonomous machines
- Constant: All recorded, catalogued, tracked

Beyond Big Brother: Transparency in 2035

Transparency: Integrates knowledge and things

- Hoarding knowledge difficult to unlikely
- Nations lose asymmetric advantage
- Knowledge shifts from nation to group to individual

Transparency provides answers to questions like:

Who are the 25,000 most influential people in the world and how many of them are within 10NM

Operations in Virtual and Live Domains

Farmed Data Display

Socially Networked

Work together

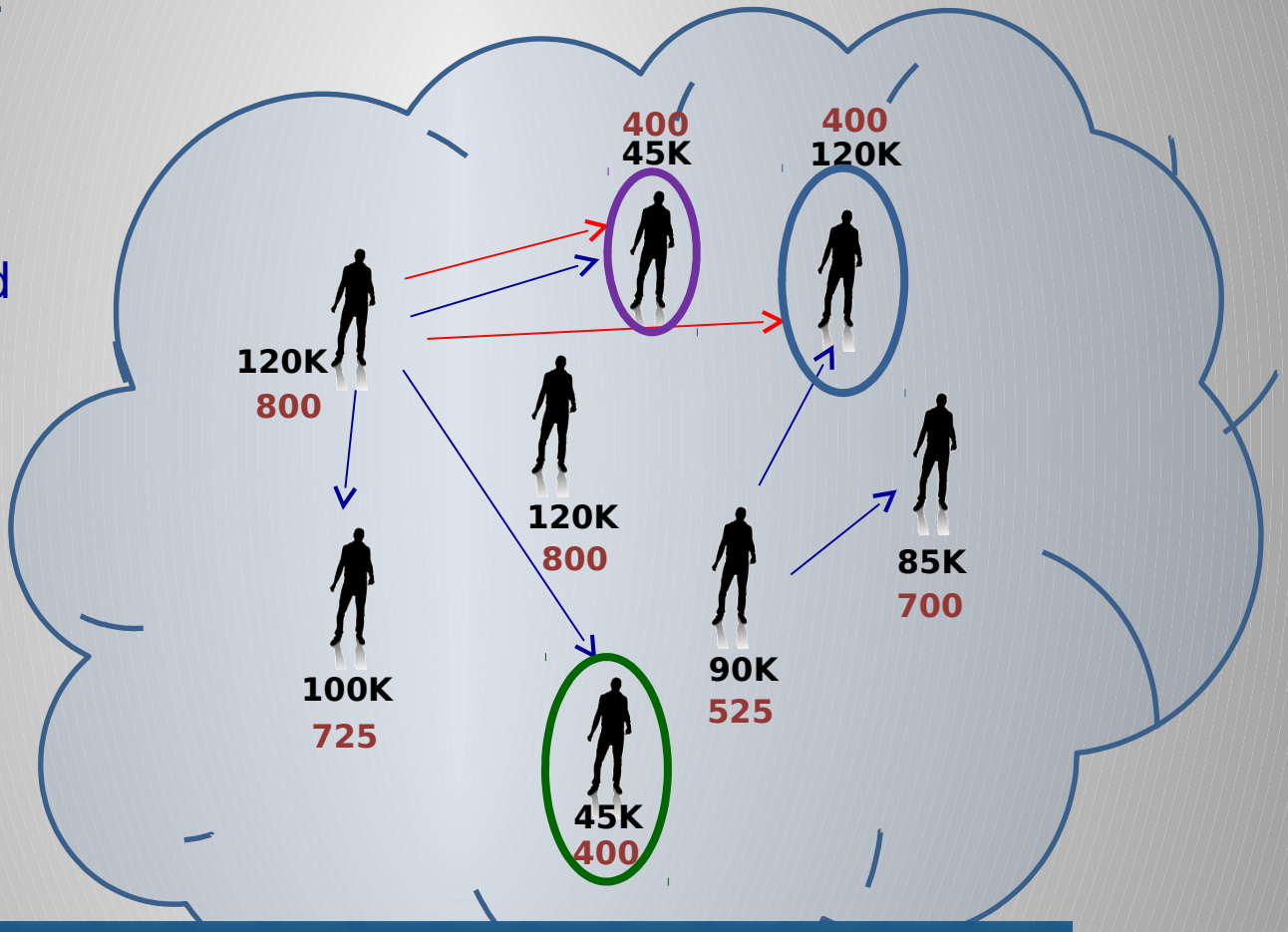
Income

Credit Score

Has Cancer

FBI Most Wanted

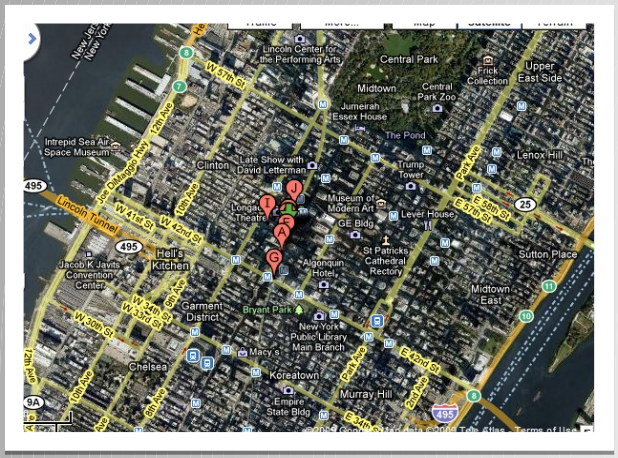
IRS Audit



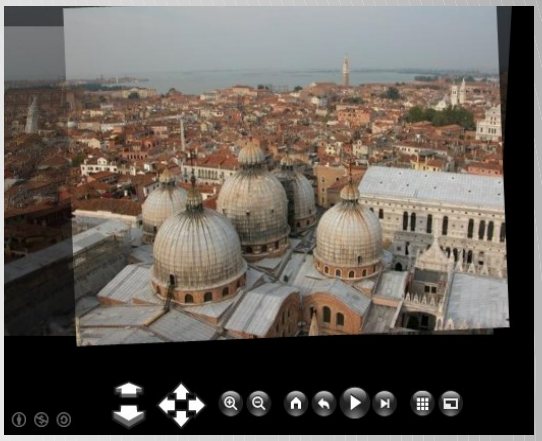
And this is 2015 . . .

Reality in Combat

Angel fire from GEO



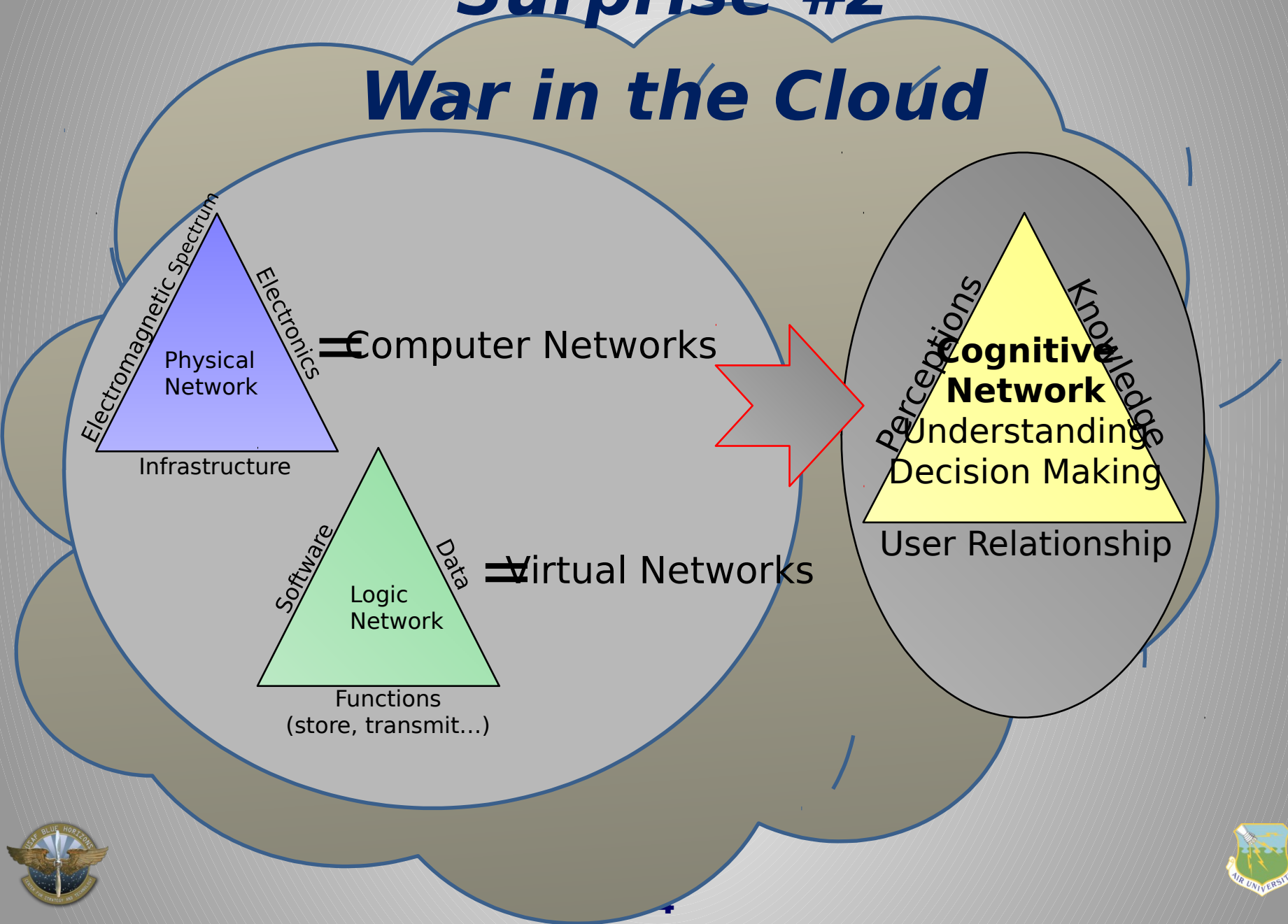
Photosynth



- Imagine what these two programs operational today. . . Will look like in 2035
  - Historical records of all movement within a city for years
  - Three dimensional exterior & Interior of buildings available to everyone in the cloud
  - On-demand instantaneous integration of terrestrial, airborne, and space sensors (e.g., Angel Fire FMV from GEO)

Surprise #2

War in the Cloud



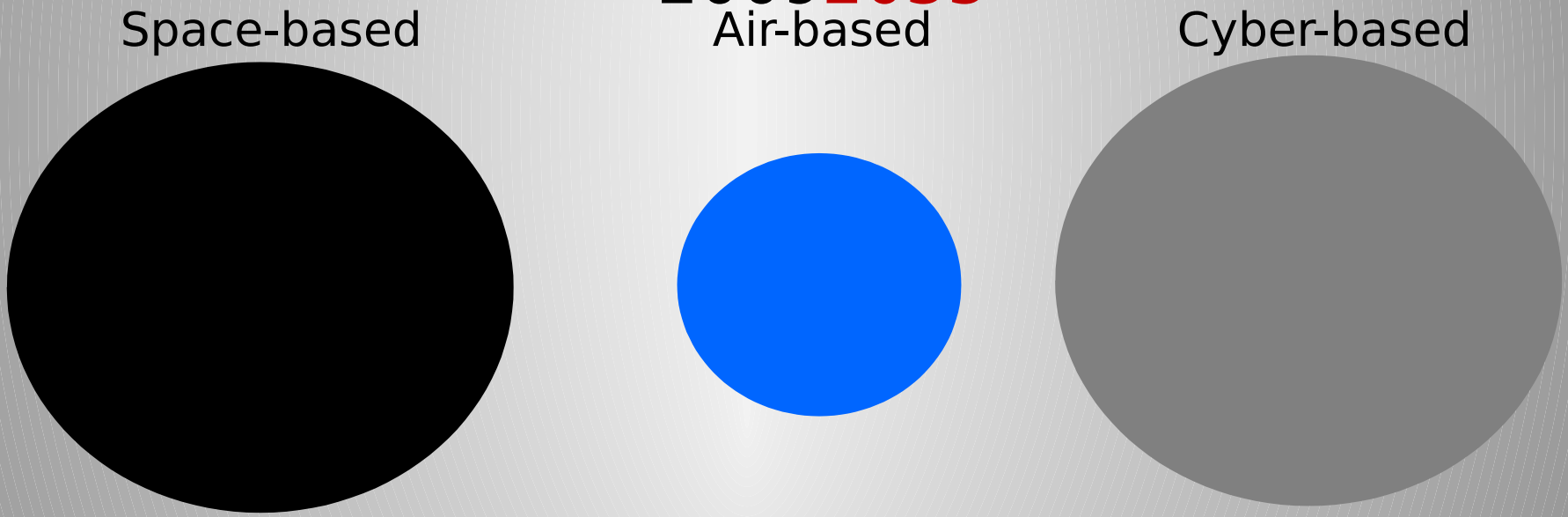
USAF Foundational Shifts

Rise of ISR in Cyberspace

"Airpower is about targets and targeting is about intelligence"

Contribution of Sensors to Situational Understanding

2009 2035



Our Cyber thinking is stovepiped and our definitions narrow . . . this is not a Cyber challenge . . . it's an Airman's problem

USAF Foundational Shifts

End of US Air, Space, Cyber Hegemony

Achieving domain superiority is a central operating tenet of air, space, and cyber power

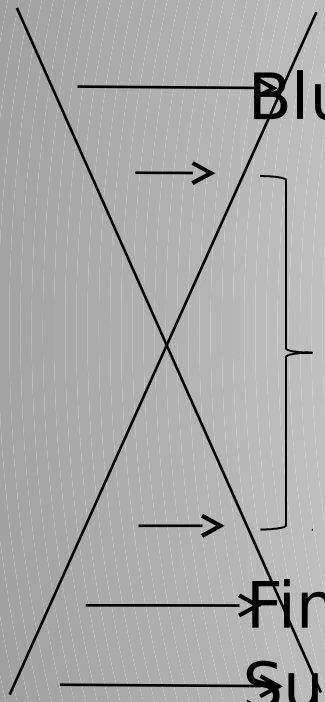
Technological leveling and innovation will

- *End the period of assured US domain dominance*
- *Revive historic thinking on degrees of domain control to enable operations, particularly in Cyber*
- *Reshape Airman's thinking to embrace less Centralized Control as battlefield automation increases and dominance ends*

By 2035, "dominance" is no longer possible . . . superiority is fleeting . . . defense increasing in importance

of transparency

Findings



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Findings

Acquisition

Education R&D

AF Culture Training

Operations

Challenge: *Compressing tech life cycle*

- We must move toward a one-year FYDP and a one-month POM, a one-week acquisition cycle with . . .
  - Continuous upgrades
  - Throw-away capabilities
  - “Any year” money
- Evolve to a World War II cycle for major systems

Findings

Challenge: *R&D no longer driven by US government*

- Unable to fully follow and report on state of technical innovation outside the United States
- Investment in basic research for military applications increasingly important
- Next **Manhattan Project**: Develop the "Rosetta Stone" for the human genome (gene to function)

Findings

Challenge: *Prepare "strategic airmen"*

- Develop Airman who:
  - Thrive on chaos and under continuous threat
  - View surprise as the norm
  - Excel under an avalanche of data
- Teach and test individual strategic thinking early and often throughout AF career
- Leverage virtual technologies to master strategic and cultural complexities

Findings

Challenge: *Air Force in danger of losing strategic relevance*

- Maintain offensive posture while increasing defensive capabilities
- It's a transparent world – AF must operate while hiding in plain sight
- Systems engineering – apply technology faster than anyone
- Cyber in 2035 will be radically different and it's a

Findings

AF Culture

Operations

Education

Training

Acquisition

R&D

***Challenge*:** *Keeping the force at the leading edge*

- Flexibility is no longer key to airpower . . . it is essential to Air Force survival
  - Mental Agility
  - Individual innovation
  - Rethink Risk: "Fail early, fail fast," then win
- More doctrine can limit flexibility

Findings

Education

AF Culture

Acquisition

Operations

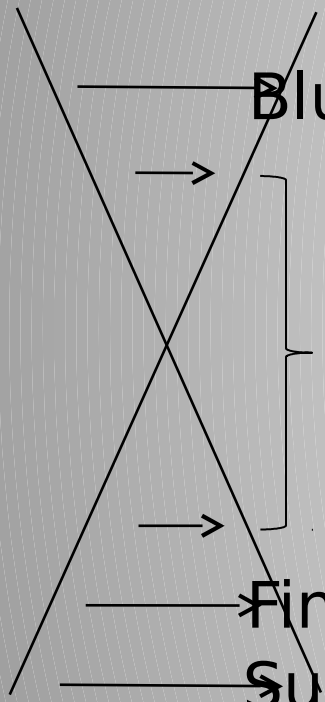
R&D

Training

Challenge: *Leaders require more strategic breadth in The Age of Surprise*

- Traditional education approach falls short
  - History and current events adequate
  - Study of <u>future</u> political, economic and military disciplines lacking
  - Little technology or impact of exponential change covered
- Technology is the engine of AF power, but we lack commitment in personnel and resources to teach

Summary and Recommendations



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What This All Means

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It's sole purpose is to introduce a way of thinking about the future that will result in changing attitudes, priorities and expectations . . .

. . . which is far harder to do but much more important

A three-degree philosophical change in direction to future Air Force strategy is needed

Recommendations

- **Operations:** Define Cyber more broadly - not just about electrons - it also includes focused operations against cognitive-social networks
- **Acquisition:** AF in 2035 will fail with the current system . . . need rapid prototype, short operational life strategy
- **R&D:** Next Manhattan Project . . . develop the gene to function “Rosetta Stone” for the human genome
- **AF Culture:** Establish agile doctrinal process reflecting rapidly changing nature of threats
- **Training:** Invest in advanced tools and technologies to better prepare them for their role as strategic Airmen
- **Education:** Make future studies a keystone of AF

Backup

Areas for Additional Research

- Nano and Bio-technologies – surge in research is not reflected in AFRL, AF/A8, or AU concepts
- Etho-cognitive Artificial Intelligence
- Pharmo-genetics
- Alternative energy sources and solutions
- Organizing the AF for operations in 2035 and beyond
- Personal Loyalty or Competence? – finding, growing, and promoting

The Road Ahead

- Blue Horizons IV – Exponential technological change in the world of 2035
  - Deterring hostile nations, groups and individuals
  - Employing highly advanced disruptive technologies
  - New threats to national survival
- Publish results of Blue Horizons III
- Develop a research plan for Blue Horizons V